

1. Estimation of research and development

The latest System of National Accounts (SNA 2008) explicitly recognises that expenditure on research and development should be recorded as gross fixed capital formation. In the ESA 2010 the decision to capitalise R&D in the core national accounts depended on a high level of reliability and comparability of the R&D estimate between EU member states. To develop highly harmonised and confident data the Eurostat Taskforce prepared templates for supplementary tables of R&D that were compulsory for the member states. Based on those supplementary tables the reliability of the data was tested and the decision was taken to capitalise R&D in the core national accounts.

Capital formation of R&D expenditure directly adds to GDP which increases the need of reliable data sources for R&D output and investment estimates.

1.1 Estimating R&D-output

This annex is based on the Eurostat grant report “Improvement in the Measurement of Intellectual Property Products” (2011) and explains the method to estimate R&D. More specifically, section 1.1 presents a description of the method to estimate R&D output while section 1.2 focuses on investments. The most important improvements compared to our ‘knowledge module’, are the estimate of R&D data by sector (besides industry), the use of other data sources such as the Structural Business Statistics (SBS) and the use of International Trade in Services Statistics. Another important point to mention is that in our system a full supply and use table (S&U-table) of R&D is constructed (before inserting the estimate in national accounts’ S&U-table). For this purpose it was necessary to create a method that led to a reasonable estimate of the producers and the users of R&D-output. The method will be described shortly in section 1.2.

The definition of R&D and its valuation according to SNA 2008 is: “Research and development is creative work undertaken on a systematic basis to increase the stock of knowledge, and use this stock of knowledge for the purpose of discovering or developing new products, including improved versions or qualities of existing products, or discovering or developing new or more efficient processes of production. Research and development is not an ancillary activity, and a separate establishment should be distinguished for it when possible. The research and development undertaken by market producers on their own behalf should, in principle, be valued on the basis of the estimated basic prices that would be paid if the research were subcontracted commercially, but in practice is likely to have to be valued on the basis of the total production costs including the costs of fixed assets used in production. Research and development undertaken by specialized commercial research laboratories or institutes is valued by receipts from sales, contracts, commissions, fees, etc. in the usual way. Research and development undertaken by government units, universities, non-profit research institutes, etc. is non-market production and is valued on the basis of the total costs incurred.”

The main principle of the Frascati (OECD, 2002) definition, that constitutes the basis for the Dutch R&D survey, is that R&D leads either to pure knowledge creation or the initial conception of a product or process innovation. In the Frascati Manual R&D covers three activities:

- Basic research, experimental or theoretical work undertaken to acquire new knowledge without any particular application or use in view;
- Applied research, is also original investigation undertaken in order to acquire new knowledge, however, directed towards a specific aim or objective;
- Experimental development draws on existing knowledge gained from research or practical experience that is directed to producing new materials, products or devices, to installing new processes, systems and services.

R&D plays a fundamental role in the competitiveness of firms by delivering the blueprints for product or process innovations. As such, knowledge created by R&D may lead to self-standing, and principally exchangeable entities. Exclusive ownership rights can be enforced by way of legal protection, maintaining secrecy or by way of having (exclusive) access to tacit knowledge (i.e. human capital) needed to provide the knowledge asset its competitive edge. The existence of economic benefits to the owner is an important precondition for knowledge to comply with the general SNA definition of an asset. Whether freely disseminated R&D (freely accessible knowledge presented in journals or on the internet) should be regarded as an asset in the SNA sense was subject to international discussion. It concerned especially R&D that is produced or financed by the non-market sector. In section 1.3 special attention is given to the treatment of freely available R&D.

R&D statistics in the Netherlands are compiled by means of the SBS of NACE 72 (*Research and development industry*), the international trade in services statistics and the Frascati based R&D survey of R&D performers such as enterprises, research institutes and universities.

The Frascati based survey includes information on the R&D related compensation of employees, other operation costs (excluding consumption of fixed assets) and capital expenditure that is needed in their R&D activity (buildings, machinery etc.). Gross expenditure on research and development (GERD) according to Frascati guidelines is calculated as the sum of these three expenditure categories. The survey also provides information on R&D purchases (by type of provider) and R&D sales (by type of purchaser) in a sort of supply and use framework. These sales and purchases do not yet include the intra-enterprise R&D (own-account R&D) produced by separate entities on behalf of affiliated producers.

Some of the recording principles of the R&D survey are not yet in accordance with the System of National Accounts. For example the Frascati based R&D surveys considers certain parts of software development as part of R&D. Supplementary guidelines are needed to define R&D output and related assets in consistency with other intangible assets covered in the system of national accounts.

Frascati based R&D statistics are translated to comply with SNA guidelines. Gross expenditure on R&D (GERD), by producer and by funder, as measured by the R&D surveys is translated to R&D-output and R&D-use (R&D expenditure) according to National accounts conventions. The steps of the translation process are discussed below:

- Reclassification of units (Section 1.1.1);
- The revaluation of R&D expenditure according to SNA guidelines (Section 1.1.2);
- The elimination of overlaps with software (Section 1.1.3);
- Inclusion of subsidies in R&D output (Section 1.1.4).

1.1.1 Reclassification of units

A part of the surveyed population of R&D research-institutes that are at present classified as part of the research-institutes industry is reclassified as part of public administration in the Dutch National accounts. For the sake of consistency with the National accounts, the same amount of GERD is moved from the research-institutes industry to public administration. The compensation of employees, other R&D operating costs and R&D related capital outlays are proportionally moved to the public administration.

1.1.2 The revaluation of R&D expenditure data according to SNA guidelines

Three different product groups are introduced in order to accomplish the translation process. These are:

- Market R&D production: this is supposed to coincide with the sales and purchases as observed in the R&D surveys.
- Non-market R&D production: this is by convention (SNA) valued by the sum of production costs. The sum of outlays as reflected by GERD does not fully coincide with the sum of production costs according to SNA guidelines.
- Own-account R&D production: according to SNA 2008 guidelines own-account production of R&D is not regarded as an ancillary activity. The SNA recommends, if possible, that separate units should be distinguished. If this is not possible, the European System of Accounts 2010 recommends that all R&D of significant size should be recorded as secondary activity. To explicitly represent the own-account R&D production, the product group is introduced in our national accounts. In the Dutch National accounts own-account production is recorded explicitly only when used as final consumption (in case of unincorporated enterprises) or when used as gross fixed capital formation (GFCF).

In the System of National Accounts, non-market (public administration and social security) output is valued by convention (SNA) as the sum of compensation of employees, other operation costs and consumption of fixed assets. Therefore, non-market R&D output is also valued by the sum of these production costs.

In the value of market R&D output, user cost of capital (e.g. user cost of machines and buildings that are used for the production of R&D) are included instead of consumption of fixed assets. The user cost of capital are estimated with the help of capital expenditures series from the R&D-survey. Capital expenditure data is used in a PIM (Perpetual Inventory Method) framework in order to calculate the user cost of capital. The calculation of the user cost of capital follows the general method prescribed by the OECD (Organisation for Economic Development and Cooperation) manual “Measuring Productivity” (OECD 2001). An extensive description of the method used to calculate the user cost of capital is given by van den Bergen, van Rooijen-Horsten, de Haan and Balk (2006).

The user cost of capital are calculated as the costs incurred when an asset is bought at the beginning of the year, used during this year, and sold at the end of the year. The user cost therefore consists of two parts. The first part is the (imputed) rent that must be paid to finance the asset. The second part is the decline (or, on rare occasions, the increase) in the value of the asset during the year. Besides the user cost of capital, a mark-up for clear profits is distinguished. In the growth accounting framework at Statistics Netherlands an exogenous interest rate, which is also called rate of return, is used. Contrary to an endogenous rate, which is in accordance with the standard neoclassical model, an exogenous rate is chosen independently of the operating surplus. The used exogenous interest rate is based on the average interest rate on outstanding bonds. This interest rate will lead to a difference between the user cost of capital and the operating surplus. Profit will therefore be non-zero. Results from growth accounting show that the profits are positive in most industries. For this reason clear profits in the valuation of market-R&D are distinguished. Since 2021 for clear profits a fixed rate of 8 percent of the sales of market-R&D as observed with the R&D survey is used.¹ Market R&D production is thus equal to the sum of compensation of employees, other operating costs, user cost of capital and a mark-up for clear profits. The sum being equal to the sales as observed in the R&D survey.

As of the 2021 revision, in the Dutch National accounts R&D own-account gross fixed capital formation is being valued at production costs (compensation of employees, other operating costs and consumption of fixed capital) including a mark-up for clear profits for market producers. Clear profits are set equal to 8 percent. For non-market R&D no mark-up for clear profits is used. All other own-account gross fixed capital formation is being valued at production costs including a mark-up of 5 percent.

Estimating R&D output

¹ There are however a few industries where the value of R&D-sales is much higher than the total costs of producing the R&D (sum of compensation of employees, other operating costs, user cost of capital for both market as well as own-account R&D). In these industries the clear profits are set equal to the difference between these sales of market-R&D and total costs in order to prevent the production value of own account R&D to become negative.

The first step in determining the R&D output value is the identification of market output. Market output coincides with the sales of R&D (based on funding questions from the R&D-survey). Non-market output then is determined as the residual sum of R&D production costs that is not attributable to market output.

In case of market R&D output it is assumed that the operating surplus consists of the user cost of capital and clear profits. The ratio / share of market R&D output (excluding the user cost of capital and clear profits) in total R&D output is used for the distribution of the compensation of employees, and other operating expenditures over market and non-market output. This leads to the total expenditure of R&D for the different industries.

In the R&D industry purchases of R&D are included in the production costs. For this industry these purchases are costs used for the production of R&D (since R&D is their primary activity). These costs are not included as part of other operating costs as registered by the R&D survey.

The procedure as explained above is followed for the determination of R&D output in almost all industries. However, in market-orientated industries all R&D output that is not attributable to market output is attributed to own-account output of R&D instead of non-market R&D output. As mentioned earlier, clear profits are set equal to 8 percent in the case of own-account R&D by market producers.

Before balancing R&D output in the Supply and Use framework of the national accounts, a number of adjustments are made. These adjustments include an adjustment for overlap with software, an adjustment for other taxes less subsidies on production and adjustments as a result of confrontations with other sources.

1.1.3 Overlaps with software

Double counting between R&D and software can occur when data are summed to obtain own-account capital formation of R&D, while at the same time the same expenditures are summed up to obtain own-account capital formation of software. It is possible that:

- R&D is performed with the aim of developing a single software original.
- Software is developed for R&D performance.

In the case that R&D is undertaken to produce software and this R&D is embodied in one single software-original, the expenditures should be excluded from R&D GFCF. If the R&D is for more than one software original then it should be recorded as R&D GFCF and the user cost of this R&D should be a part of software GFCF. It is of course very difficult to differentiate between the two cases.

Another case is that software is produced to undertake R&D. It seems reasonable to treat this in the same way as R&D undertaken to produce software. When the software is embodied in a single R&D original the expenditure on the software should be excluded from estimates of

software GFCF. When the software is used for producing more than one R&D original, the expenditures on the software should be recorded as GFCF and the services the software provides should be included in the cost of producing R&D in the future.

The conceptual treatment of GFCF and intermediate consumption of R&D and software is clear. However it is unclear what the method should be to differentiate between GFCF and intermediate consumption. Most countries will probably have no data available for this differentiation. In order to make comparisons between countries, it is important that methods are harmonized. Therefore guidelines should be constructed on how to differentiate between GFCF and intermediate consumption.

An adjustment of -50% of the R&D in the software services industry is made (NACE 62) to prevent double counting of own-account gross fixed capital formation in the software services industry for the case that R&D is undertaken in a production process and leads to a software original. The assumption is that this case can only occur in the software services industry. Therefore, the adjustment for overlaps in the R&D satellite account is limited to the software industry (NACE 62). Because the overlap concerns own-account GFCF the same adjustment has to be made on R&D output of own-account GFCF (production equals investment in case of own-account GFCF).

Possible overlaps with other fixed intangible capital are not investigated at this time. Overlaps could occur in case of mineral exploration, entertainment and artistic originals. However, from the Frascati guidelines it becomes clear that these overlaps are quite insignificant.

1.1.4 Other taxes less subsidies on production

The subsidies on production consist of a general subsidy on labour costs of R&D performing personnel (1,359 million euro in 2021). Information on these subsidies is obtained from the national accounts. The subsidy is distributed among the industries in proportion to labour costs (excluding public administration and social security industry and non-market production of the subsidized education industry). Market R&D is directly valued according to the total sales and should remain the same after subtraction of the subsidies. The subsidy that should be subtracted from market R&D leads therefore to a new allocation of the compensation of employees and other operating costs between market and own-account production. Subtracting subsidies will lead to higher production costs (compensation of employees and other operating costs) in case of market R&D and lower production costs in case of own-account R&D.

1.1.5 Other adjustments

Other adjustments between GERD and the R&D output are adjustments that are related with confrontation with source data other than the R&D-survey. Examples are: confrontation health care supply statistics, international trade in services statistics, and S13 R&D-institutions annual reports (R&D totals from the government statistics department based on COFOG-data).

Adjustment for NACE 72 (assumption that all R&D output is market R&D output and is sold to related units in the other NACE categories).

Adjustments before inserting the data R&D output data in the supply and use framework. These adjustments aim to correct for supply and use differences in the estimate, small errors and so forth.

1.2 From R&D output to GFCF

On the macro-level the step from R&D output to GFCF seems quite easy. However identifying the investing industries is a difficult task. It means that the buyers of market-R&D output must be identified. At Statistics Netherlands this is done with the help of the R&D survey in which the R&D sales (by type of purchaser), and the purchases (by type of provider) can be identified. Both of the variables are however not consistent (on the aggregate level). There is a huge difference in level. Since the levels of the R&D sales are considered more plausible, the choice is made to adjust the purchases to the level of the sales.

References

Tanriseven, M. (2011), 'Improvement in the Measurement of Intellectual Property Products', Eurostat Grant Report.